



Sand Dune and Shingle Network

23rd Newsletter, June 2025

Linking science and management



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Introduction



Paul Rooney
Network Director

Welcome to the 23rd newsletter from the Sand Dune and Shingle Network. The Network has existed as an

informal arrangement from the late 1980s but was formally launched in December 2006 at a 'Biodiversity Action Planning' conference in Liverpool. Our first newsletter was published in May 2007. We organised two field-based workshops that year, one at Newborough Warren NNR, Ynys Mon, Wales and the other at Lossiemouth Forest, Moray, Scotland. We then focussed on organising an international dune conference in Liverpool in 2008. The network has grown and furthered its reach since those early days, particularly across Europe.

Our latest newsletter reports on a series of network events along with reports on latest research. We hope these items help to link science and management practices. We have two exciting events planned, including a conference in September, but don't forget to promote 'World sand Dune Day' on Saturday 28th June!

Reflecting on our success over the years and looking forward with excitement to the future plans, it is clear to me that the network is much needed and valued. The partnerships we have formed are strong. Much of this is owed to the work of the 'Dynamic Dunescape' and 'Sands of Life' projects. There is a bright future for our network. Thank you for your support.

Network News



Thomas Smyth
Network Assistant

It has been an exciting and productive six months since joining the Sand Dune and Shingle Network as Network

Assistant in September 2024. A major highlight has been hosting and supporting several events. In January our New Horizons in Dunes and Shingle conference, gave a wide range of early career scientists from around the world the opportunity to present their research to practitioners, experts and enthusiasts. Our machair webinar in February explored developments in research since 1980, offering valuable insights into this unique habitat. We also facilitated knowledge-sharing event on foredune notching, a technique increasingly used in coastal management to encourage natural dune restoration. Most recently we have hosted our first field visit to Cemlyn in Wales. These events have been a great success and helped strengthen connections between researchers, conservationists, and policymakers.

This issue of the newsletter briefly summarises some of the Network's key events since our last issue in November 2024 but also introduces a new reoccurring feature in our newsletters called 'Site Spotlight'. In this issue we feature Red Rocks Nature Reserve on the Wirral, in north-west England.

Since our last newsletter there has also been considerable number of peer-reviewed research relevant to sand dunes, coastal shingle and machair, which we list and summarise from page 19. This growing body of work reflects the vitality and diversity of ongoing efforts in coastal science and conservation.

Looking ahead, we are excited to announce that the next Sand Dune and Shingle Network conference will take place from **16th–18th September 2025**. Further information about the conference can be found on page 18.

Machair: Reflecting on Past Research and Shaping the Future

Dr Thomas Smyth, Sand Dune and Shingle Network Assistant



Machair at Gallanach on the Isle of Coll, Scotland (Image: NatureScot)

Introduction

Machair is a distinctive coastal landscape typically defined as a plain of wind-blown shell sand supporting a characteristic herb-rich vegetation that is globally restricted to the northwest of Scotland and the northwest of Ireland (Ritchie, 1976; Angus, 1994). The term ‘machair system’ is commonly applied in a broader sense to encompass associated landscape elements such as freshwater lochs, marshes, tidal flats, saltmarshes, and the inland transition zone known as blackland, which forms the interface between machair and moorland (Angus, 2001).

Machair systems are of considerable ecological, cultural and historical significance. They support a high diversity of flora and fauna, including nationally important populations of ground-nesting birds and rare invertebrates. In addition, the archaeological and palaeoenvironmental record preserved within machair deposits offers valuable insights into human settlement and land-use change over millennia. Critically, these landscapes are shaped and maintained by traditional agricultural practices, particularly crofting, which play a central role in their ecological functioning and cultural identity (Angus, 2001). The future conservation and management of machair is therefore contingent on the continua-

tion of these land-use practices and the active engagement of local communities, whose knowledge of the landscape remains extensive.

Despite the breadth of disciplinary interest in machair, there has been no systematic review of the academic literature since the proceedings of the third Machair Conference (‘Machair 3’) held in 1978 and published in 1981. That volume included a comprehensive bibliography covering research up to 1979. This article seeks to extend that effort by reviewing peer-reviewed academic publications from 1980 to 2024, thereby providing an overview of trends in machair-related research over the past four decades. In doing so, it aims to identify areas of sustained scholarly interest, highlight emerging themes, and suggest directions for future inquiry.

Methods

This review draws on peer-reviewed academic literature published between 1980 and 2024 that focuses substantively on machair systems. The review was designed to extend the existing bibliography published in the proceedings of the 1978 ‘Machair 3’ meeting, which included literature up to the end of 1979.

Publications were identified through a combination of key-word-based searches and targeted exploration of journals known to have published relevant work.

To facilitate comparison with earlier reviews and to structure the synthesis of findings, each publication was assigned to one or more thematic categories. These categories mirror those used in the 1978 bibliography: Geology and Geomorphology, Archaeology, Historical Descriptions, Agriculture and General Land Use, Botany and Zoology. In recognition of the growing relevance of applied and policy-related research, two additional categories were introduced Management and Policy and Classification.

Several limitations to the scope of the review should be noted. First, books, book chapters, and grey literature (including government and NGO reports) were excluded. This decision reflects the focus on peer-reviewed sources but results in the omission of several influential and widely cited texts, particularly those related to archaeology. Second, the inclusion of articles published in thematic journal issues has led to a concentration of publications in certain years. Notable examples include the 1983 'Hebrides Section' of the *Wader Study Group Bulletin* and the 2009 proceedings of the 'Machair Conservation: Successes and Challenges' conference, published in *The Glasgow Naturalist*. These peaks in publication volume should therefore be interpreted with caution.

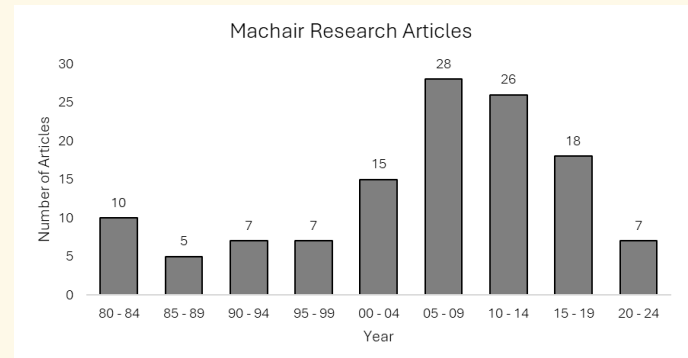
Temporal Distribution of Publications

In total 123 articles relating to machair ecosystems were reviewed. Initial activity in the early 1980s was modest, with 10 articles published between 1980 and 1984, followed by a decline in the late 1980s ($n = 5$). Output remained relatively low through the 1990s, but this was followed by a marked increase in the early 2000s. Between 2000 and 2004, the number of publications more than doubled relative to the previous period, reaching 15. The peak occurred between 2005 and 2009, with 28 articles published, many of which were associated with the 2009 Glasgow Naturalist special issue following the "Machair Conservation: Successes and Challenges" conference. High output continued through 2010–2014 ($n = 26$), before declining slightly in 2015–2019 ($n = 18$). A reduction is evident in the most recent period (2020–2024, $n = 7$).

Geographic Distribution of Studies

The geographic focus of the reviewed literature has overwhelmingly been on Scotland, which accounted for 92% of all publications. The Outer Hebrides, particularly the Uists, featured prominently. Ireland represented only 6% of the total, with studies concentrated in the northwest counties

where machair occurs, such as Mayo and Donegal. A single study was conducted in New Zealand, examining dune grassland systems with similarities to machair.

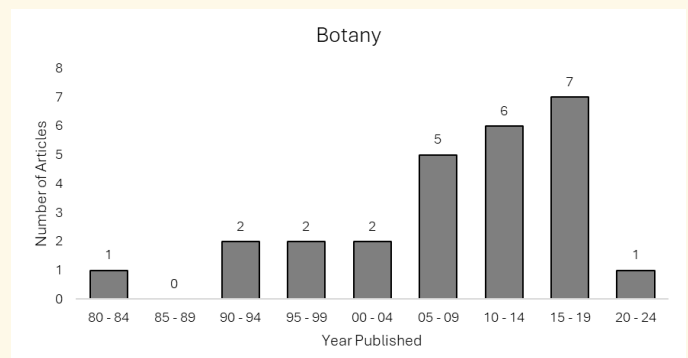


Number of machair related research articles since 1980.

Thematic Trends in Research

Across the study period, the most common categories of research were Botany ($n=26$), Zoology ($n=24$), Management/Policy ($n=23$) and Geology/Geomorphology ($n=23$). Many publications spanned multiple thematic areas, reflecting the interdisciplinary character of machair studies. Only a single article, Hansom and Angus (2005), served as a general overview of the machair system. The limited number of integrative reviews highlights a lack of literature drawing together cross-disciplinary insights over time.

Botany ($n=26$)



Botany related machair research articles since 1980.

Botanical research on the machair has progressed from descriptive and palaeoecological studies to trait-based analyses that explore how plant communities respond to environmental drivers. Key trends included a move from qualitative surveys to functional ecology, with a growing focus on land use, disturbance, and long-term change.

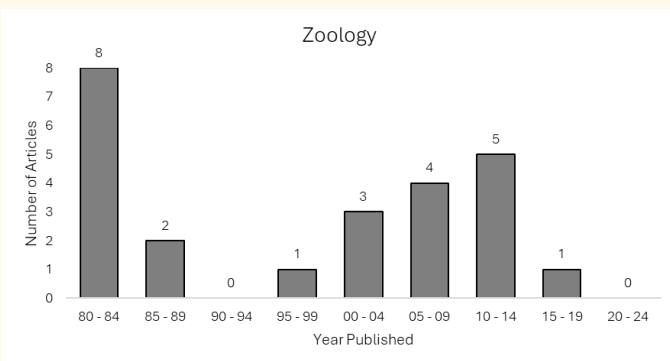
Initial work highlighted the ecological distinctiveness of machair vegetation (Randall, 1983). Surveys in the 1990s mapped plant communities and environmental gradients, particularly on South Uist (Kent et al., 1994), and synthesised vegetation patterns across the Outer Hebrides (Owen et al., 1996).

Further studies explored site-specific processes such as seed dispersal and community dynamics (Owen et al., 1998; Owen et al., 2001).

By the 2000s, research focused on the impacts of disturbance. Sand burial was shown to affect species composition (Owen et al., 2004), while experiments demonstrated differential photosynthetic responses (Kent et al., 2005). Related studies in Ireland examined how grazing and recreation influenced vegetation structure (Cooper et al., 2005; Gaynor, 2006). In the mid-2000s research adopted trait-based approaches. Pakeman and Quested (2007) assessed sampling effort for functional traits, and Pakeman et al. (2008) examined how multiple environmental factors shape species' ecological preferences.

Between 2014 and 2017, studies led by Lewis and Pakeman applied spatial modelling and functional indicators to assess biodiversity. Recent long-term studies reveal both stability and change. Species composition in coastal dunes showed little overall change over 30 years (Pakeman et al., 2015), yet nitrogen deposition and climate trends are altering trait structures and driving turnover (Pakeman et al., 2016; Lewis et al., 2016). This was further investigated through species abundance and richness analyses (Pakeman et al., 2017a; 2017b).

Zoology (n=24)



Zoology related machair research articles since 1980.

Zoological studies on the machair have focused primarily on breeding bird populations, particularly waders, and their interactions with habitat, predators, and land management. Over time, research has evolved from baseline surveys and methodological development to conservation-focused analyses of predator impacts, landscape-scale trends, and agricultural influences. A secondary but growing interest concerns invertebrates, notably bumblebees and mites, reflecting diversification in taxa of conservation concern.

The earliest zoological studies, concentrated in the 1980s, laid the groundwork for understanding breeding bird use of the machair landscape. Fuller (1981) and Etheridge (1982) documented habitat preferences of breeding waders such

as Dunlin (*Calidris alpina*), identifying the machair as critical for high-density nesting. The 1983 volume of the *Wader Study Group Bulletin* became a focal point for field methods and inter-observer variability (Fuller et al., 1983; Green, 1983; Reed & Fuller, 1983; Reed et al., 1983; Jackson & Percival, 1983; Webb et al., 1983), reflecting the need for standardised survey protocols in these complex habitats.

The 1990s and early 2000s introduced a strong emphasis on conservation. Studies began tracking long-term changes and investigating drivers of decline. Fuller & Jackson (1999) reported that large declines in waders had occurred between 1980s and 1995 particularly on South Uist and Benbecula. One of the most striking developments in this period was the identification of the introduced hedgehog (*Erinaceus europaeus*) as a major predator of wader eggs on South Uist (Jackson & Green, 2000; Jackson, 2001). Subsequent studies expanded on these findings, revealing broader effects of predator introductions on population trends (Jackson et al., 2004) and exploring the reproductive biology and population ecology of the introduced hedgehogs themselves (Jackson, 2006, 2007).

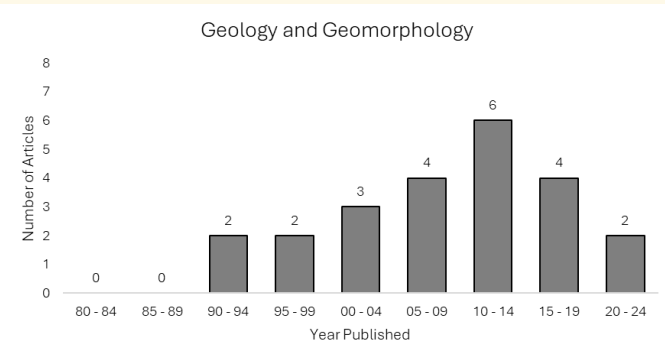
The 2000s also saw diversification of species under investigation. Wilson et al. (2007) explored the status of the corn bunting, linking population declines to modern harvesting practices. Meanwhile, Wilkinson & Wilson (2010) studied the breeding ecology of Twite (*Carduelis flavirostris*),

A parallel shift occurred in taxonomic focus with the inclusion of invertebrates. McCracken (2009) highlighted the role of habitat mosaicism in supporting diverse invertebrate communities, and Redpath et al. (2010) demonstrated how crofting practices affect bumblebee populations. Arroyo & Bolger (2011) added to this body of work by surveying the mite fauna of Irish machair, further underlining the unique invertebrate biodiversity of these systems.

Efforts to track long-term changes have continued into the 2010s. Fuller et al. (2010) compared wader populations between 2000 and 2007, finding major changes in population that remained poorly understood. Calladine et al. (2014) integrated data on birds, vegetation, and land use, revealing complex interactions among ecological and socio-economic drivers. Most recently, Calladine et al. (2017) revisited the issue of hedgehog predation, showing that its effects remain detectable four decades after introduction.

In summary, zoological research on the machair has matured from foundational avifaunal surveys to integrative, conservation-driven investigations. Studies have illuminated how land use, invasive species, and agricultural intensification shape the abundance and distribution of key species in machair.

Geology and Geomorphology (n=23)



Geology and Geomorphology related machair research articles since 1980.

Research on the geological and geomorphological development of machair landscapes provides a long-term perspective on the formation, evolution, and vulnerability of these coastal systems. Early contributions such as Mate (1992) offered theoretical frameworks for machair development, while empirical reconstructions by Ritchie and Whittington (1994) and Whittington and Edwards (1996) used sedimentary and palynological evidence to trace Holocene aeolian dynamics and vegetation succession. These studies highlighted the spatial and temporal variability of sand movement and soil development across the Uists and Benbecula.

The late 1990s saw more integrated landscape histories emerge, most notably Gilbertson et al. (1999), who examined over 14,000 years of climatic, geomorphological, and anthropogenic change along the North Atlantic coast. The 2000s continued this trend with an emphasis on coastal sensitivity and storm impacts. Sommerville et al. (2003) used luminescence dating to investigate storm deposition and shoreline mobility, while Ritchie et al. (2001) provided a detailed synthesis of Holocene physiographic changes in the Uists. Later, Dawson et al. (2007) and Angus and Rennie (2014) focused specifically on the "Great Storm" of January 2005.

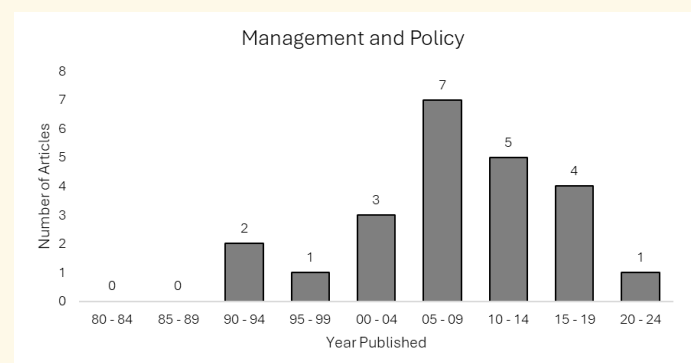
Throughout the 2010s, the field evolved towards greater technical sophistication and spatial scale, with satellite imagery and modelling increasingly incorporated. Cooper et al. (2012) and Dawson et al. (2012) explored how antecedent geology influences barrier morphology, introducing the concept of bedrock-controlled barrier islands. Gómez et al. (2014) further developed shoreline change assessments using historical data and Landsat imagery, deepening understanding of long-term coastal vulnerability.

Aeolian processes remained a consistent theme, with studies such as Orme et al. (2016a; 2016b) reconstructing storminess over the past 1800 years using high-resolution sediment cores and micro-XRF scanning. Pile et al. (2019)

analysed the stratigraphy and internal structure of wind-dominated barrier islands, affirming the significance of dune dynamics in shaping machair geomorphology.

In parallel, soil-focused studies bridged the geomorphological and ecological, examining the effects of land use, erosion, and wind abrasion. Vink et al. (2009, 2014, 2020), Thorsen et al. (2010), Young et al. (2015), and Rennert and Herrmann (2020) provided insights into soil microbial communities, nematode ecology, and the influence of sea spray and agricultural inputs on soil structure. Collectively, these studies illustrate the intimate connection between geomorphological processes and soil ecology on machair, revealing both the fragility and resilience of this complex landform under environmental and anthropogenic pressures.

Management and Policy (n=23)



Management and Policy related machair research articles since 1980.

Research focused on the management and policy dimensions of machair ecosystems has grown steadily over the past three decades, reflecting a widening recognition of the complex socio-ecological dynamics involved in sustaining these landscapes. Early work in the 1990s, such as Crawford (1990; 1997) and Angus and Elliot (1992), primarily addressed the impact of agriculture and erosion, with attention given to the tensions between traditional land use and ecological vulnerability. These studies laid the groundwork for more structured conservation efforts in the 2000s, particularly through contributions such as Angus (2001) and Angus and Dargie (2002), which reported on the development and implementation of the UK Machair Habitat Action Plan (HAP).

Through the 2000s, research increasingly reflected collaborative approaches to management, recognising crofters as key stakeholders in conservation. The Glasgow Naturalist's 2009 special issue marked a peak in publication volume and thematic breadth, with articles on habitat management for native plants (Long, 2009), agrobiodiversity and rare species (Beaumont & Housden, 2009; Scholten et al., 2009), and integrated conservation strategies involving local

communities (Walton & MacKenzie, 2009). These contributions underscored the importance of aligning biodiversity goals with traditional practices such as cropping and grazing.

Climate change emerged as a major theme in the 2010s, particularly in the Outer Hebrides, with multiple articles considering the vulnerability of machair to sea-level rise, storm surge, and changing rainfall regimes (e.g. Angus & Hansom, 2006; Muir et al., 2014; Angus, 2014). These studies not only addressed environmental threats but also explored opportunities for community-led adaptation, including the use of soft-engineered coastal defences (Young et al., 2014). A further shift in this period was the growing integration of machair management within ecosystem services frameworks, as seen in Eastwood et al. (2016), who evaluated the role of conservation interventions in enhancing ecosystem service delivery.

Recent contributions have extended these themes into broader discussions of landscape resilience and planning for a changing climate (Angus, 2018; Angus & Hansom, 2021). The only explicitly Irish example in the dataset, Gorman et al. (2018), applied a rapid assessment framework to machair habitat quality. Overall, the management and policy literature revealed a trajectory from early descriptive and technical assessments towards increasingly integrated, adaptive, and participatory approaches, shaped by both environmental imperatives and cultural values.

Discussion

Machair research began with a phase of growth during the 1980s and 1990s, marked by foundational studies in geomorphology, palaeoecology, and archaeology. These early works often provided broad characterisations of machair systems, laying essential groundwork through general descriptions of geomorphic and ecological processes. Over time, the focus has shifted toward more specific phenomena, including erosion dynamics, plant-soil interactions, and habitat change.

This momentum continued into the early 2000s, peaking between 2001 and 2010 with a surge of interdisciplinary and applied research. During this period, traditional ecological and geological studies were increasingly complemented by work in soil science, hydrology, and land management, reflecting a growing interest in the interaction between natural processes and human or cultural dimensions. The application of advanced techniques, including remote sensing, environmental modelling, and palaeoecological reconstruction, allowed researchers to investigate longer-term dynamics and more complex system behaviours, supporting a shift from short-term surveys to longitudinal analyses.

Publication rates, however, have declined steadily since the mid-2010s, with a particularly notable drop-off after 2020. This trend may reflect both structural and logistical constraints on research. The COVID-19 pandemic, with its restrictions on travel and fieldwork, likely disrupted ongoing and planned field-based studies. At the same time, longer-term institutional factors may also be involved. The UK's Research Excellence Framework (REF), which increasingly prioritises outputs with demonstrable international impact, may discourage sustained attention to geographically specific systems like the machair, which are restricted to relatively small areas on the northwest coasts of Scotland and Ireland.

The geographic distribution of research has remained strongly skewed toward Scottish sites, particularly in the Outer Hebrides. This reflects both the spatial extent of machair in Scotland and a well-established disciplinary interest in its landscapes, particularly within archaeology, coastal geomorphology, and palaeoecology. In contrast, Irish machair systems are relatively underrepresented. This disparity highlights an opportunity for expanded comparative work, particularly as both nations face common challenges related to land-use change, agricultural intensification and climate change.

In more recent work, there has been a gradual but noticeable shift in emphasis toward conservation, sustainability, and ecosystem services. Research now increasingly considers machair within the context of global change, exploring the vulnerability of these systems to sea-level rise, changes in precipitation regimes, and biodiversity loss. As machair habitats face growing environmental pressures, studies have begun to interrogate the trade-offs between agricultural use, ecological integrity, and cultural heritage. Together, these developments point toward a maturing research field that is increasingly interdisciplinary, applied, and aligned with contemporary environmental priorities, yet in need of renewed focus and investment to remain relevant and impactful.

Machair Literature Database

The complete database of machair-related literature used to compile this article is available to access via the Sand Dune and Shingle Network's *Resources* webpage: <https://coast.hope.ac.uk/externalresources/>. It is intended as a living resource to support ongoing research, conservation, and policy work related to machair ecosystems. If you are aware of additional relevant publications, whether new or historical, that could enhance the collection, please get in touch by emailing: dunes@hope.ac.uk.

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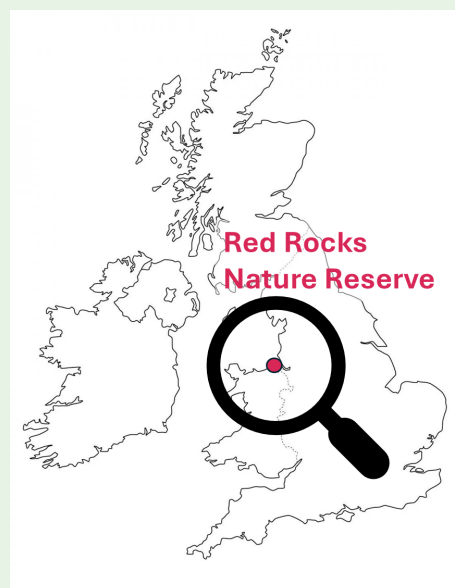
Site Spotlight: Red Rocks Nature Reserve, England

Protecting Cheshire's last natural dune system

Carys McMillan, Community Officer, Cheshire Wildlife Trust

RRNR is a Site of Special Scientific Interest (SSSI) and is located on the Wirral Peninsula, between the towns of Hoylake and West Kirby, looking out to Liverpool Bay. The site is split down the middle by a boundary fence which separates the operational area of the golf course on the landward side and the publicly accessible reserve on the seaward, both owned in large part by Royal Liverpool.

Red Rocks Nature Reserve (RRNR) is managed by Cheshire Wildlife Trust (CWT) and in more recent years by Our Dee Estuary Project (ODE), a partnership project designed to reconnect people along the Dee Estuary, across both England and Wales, with its natural heritage.



Red Rocks Nature Reserve on the Wirral Peninsula, England



Natterjack Toad Survey

Through habitat management and conservation works we are hoping to improve the key habitats we have here, improve dune system dynamism and improve biodiversity. This of course all must be achieved in a sustainable way which allows continued local community access without negatively impacting the amazing mosaic of habitats present at this site.

Despite RRNR's relatively small size of 11.63 ha, the land boasts a range of important habitats such as: embryo and mobile dunes, fixed dunes, grassland and wetland reedbed. The site is also home to the only breeding population of Natterjack Toads on the Wirral, which are a protected species with a limited UK distribution.

The current dune system is predicted by Natural England to be around 4.4 ha and historic maps show that the sediment levels are rising with embryo dunes extending seaward. This

means that the special features and habitats of this reserve are also extending beyond the reach of the SSSI. Saltmarsh plant species are developing in front of these embryo dunes which provide another valuable habitat with many rare plant species recorded in 2024 plant surveys.

Habitat Management Achievements

Management efforts have been aiming to improve the coastal habitats on this site through sea holly replanting, large scale works involving creating scrapes, scything of reedbeds on a rotational cycle, invasive plant species removal and wildlife surveying which monitors and ensures that the conservation works are paying dividends as intended. Sand patching across the seaward facing dunes has improved access to bare sand, creating mobile sand to encourage dynamism within dune systems as well as to offer opportunities for species who benefit from bare sand.



Unvegetated Sand Patch (Photo: Graeme Skinner)

Coarse grasses have become hugely prominent at this site and although essential in dune development and stabilisation, the density of the grasses such as Marram and Lyme grass is outcompeting other dune species and over stabilising the dunes, resulting in a lack of free moving sediment. Volunteers at RRNR have created upwards of 17 sand patches across the seaward dune ridge, a fantastic result for some of RRNR's priority species.

In 2022 and 2023, CWT and Chester Zoo delivered a sea holly replanting scheme in the dunes at RRNR. Seed was taken from site, grown on within the Zoo's dedicated nursery space and replanted on site to increase success of establishment. Surveys in 2024 proved that the sea holly has spread southwards down the reserve and is developing in other patches of dunes and grassland. There are now around 60 individual plants, some of substantial size.



Sea holly planting

Reedbeds add significant diversity to the site and are of high importance for nesting bird species and migratory species. Reeds also offer a filtration process. However, it may be increased nutrient run off from surrounding land that is causing the large increase in reed growth and its encroachment into other areas on the site. Therefore, the reedbed on the seaward side, is heavily managed by being cut in sections each year to try and reduce its encroachment on other habitats, as well as to keep it healthy with differing structures and ages and therefore entice a wide diversity of invertebrates and birds.

Other recent management has involved removing small trees and scrub - improving the coverage of trees and scrub to a lower level more suitable to dune grasslands. However, some scrub and tree cover are important to be left due to the site's significance for bird species. Management also involved using machinery to create scrapes in reedbeds, creating access to open water pools in the dune slacks that are not encroached by reeds.



Volunteers managing reedbeds (Photo: Graeme Skinner)

RRNR does unfortunately have some invasive species. There is sea buckthorn at the north of the site which will require ongoing maintenance to reduce its spread further across the site. Another common invasive of dune systems is *rosa rugosa*, which is monitored by the team and removed manually as new patches are discovered.

Limitation and Challenges

It hasn't always been easy to maintain or manage the habitats here. One of the main limitations is the dynamic nature of coastal habitats. The ebb and flow of the tide limits our access to the site as high water cuts off the slipway access to the reserve. Therefore, any work must be scheduled around low tide. This has reduced the flexibility of using machinery to carry out large scale works as it's not quite as simple as being able to access the site at any time of day. Extreme weather patterns, such as the storms of April 2024, can also cause issues for access for works as it reduces the accessibility for large and heavy machinery by saturating land so that it is too wet for heavy vehicular access.



Machinery working on site

A lot of the work we can carry out is during the winter months. Poor weather at this time of year also limits the amount of work that can be carried out by hand, often leading to the rescheduling of practical volunteering sessions, as well as the reduction in the capacity of works that can be completed due to a lack of opportunities to get down to the coast.

Given the location of this dune system, being nestled between two large coastal towns, disturbance at this site is high with most common uses for the site being for recreation and dog walkers. Therefore, balancing public access with conservation needs is a delicate task. Heavy footfall causing eroding dunes and high nutrient inflow to the site are some of the largest issues at RRNR for habitat management.

Additionally, one of the limitations at RRNR is the rare habitat and the species that call it home themselves. Due to their protected status, work is limited to certain times of year around breeding seasons. These times of year do not

necessarily always fit well with the weather seasons making habitat management hard and sometimes impossible.

Finally, climate change and rising sea levels are a large factor for concern moving forward. It's hard to predict how to manage a coastal site that is so heavily impacted by increased or decreased sediment flow from changing tides, weather and sea levels.

Summary

Red Rocks Nature Reserve is a vital and beautiful part of the Wirral Peninsula, offering a snapshot of the region's diverse coastal ecosystems. While significant conservation work has been undertaken to protect and enhance the habitats, ongoing challenges like reedbed encroachment, climate change, and human disturbance require continued effort. Future habitat management will need to be adaptable and resilient to ensure that Red Rocks remains a haven for wildlife and a natural asset for future generations.



Sea holly growth in summer 2024

New Horizons: Pioneering Research in Dunes and Shingle

Dr Thomas Smyth, Sand Dune and Shingle Network Assistant

The New Horizons in Dunes and Shingle conference, held on 22nd January 2025, brought together a community of early-career researchers and experts to exchange insights into the management, monitoring, and morphodynamics of coastal dune, machair and shingle environments. Hosted and coordinated by the Sand Dune and Shingle Network, this inaugural one-day conference featured twelve presentations, grouped into three thematic sessions. With over 100 participants attending from eleven countries, the event was a resounding success.

Theme 1: Coastal Dune Management and Restoration

This first session focused on practical interventions and assessment frameworks to restore dynamic coastal processes. Thomas Pagon kicked off the session with a global analysis of foredune notches. By evaluating 133 notches using aerial imagery and ten years of remote sensing data, a new classification framework was presented to guide land managers in designing more resilient dune interventions. Next, Maud van Soest shared results from the [Sands of LIFE project](#), examining soil condition changes following notch creation and slack reprofiling at Welsh dune sites. Her findings highlighted how restoration can reintroduce early successional conditions, though outcomes varied depending on varying wind conditions, intervention scales, and pre-existing geomorphology. Silvia Cascone concluded the session by presenting a revised Dune Vulnerability Index tailored to the high-energy environments of northwest Ireland. By streamlining the indicators and focusing on quantitative metrics, her research provides a practical tool for targeting nature-based solutions.

Theme 2: Innovations in Coastal Monitoring and Assessment

The second session of the conference focused on cutting-edge techniques for understanding coastal change. Yixuan Chang provided a compelling long-term case study of Sheskinmore Dunes in northwest Ireland, analysing land cover and geomorphic shifts from 1951 to 2023. By combining historic aerial imagery and Sentinel-2 data, she demonstrated the power of integrating remote sensing with field interpretation. From the other side of the Atlantic, Timothy Baxter presented a statewide assessment of dune loss in California. Timothy's presentation revealed that up to 98% of dunes have been lost in some urban areas, pointing to the urgent need for restoration. Concluding the session, Umberto Andriolo introduced a drone-based method to monitor macro-litter in Portugal's dunes. His findings on

how litter accumulates in blowouts and foredunes offered practical insights for targeting clean-up and mitigation efforts.

Theme 3: Dynamics and Evolution of Coastal Dune Systems

The third session explored aeolian processes and dune morphology in greater depth. Antoine Lamy opened with a computational fluid dynamics study of a human-made dune at Leucate, France, demonstrating how construction differences have influenced wind flow separation and sand transport patterns two decades after initial intervention. Camille René followed with a LiDAR- and UAV-based investigation of blowout morphology in a trough altered by foot-path use. Camille's research revealed the impacts of bidirectional winds and anthropogenic disturbances on blowout dynamics. Jules Buquen shared results from a ten-year LiDAR study of the Pilat Dune, Europe's tallest coastal dune. Jules quantified alongshore variability and landward migration, offering vital data for future morphodynamic modelling. Finally, Matthew Withers presented on embryo dunes at two UK sites, Sutton-on-Sea and Fylde, demonstrating how local management practices were key in shaping early dune formation, suggesting embryo dunes can be strategic tools in sustainable coastal defence.

Closing remarks

The day highlighted not only the breadth of new scientific research but also the strength and enthusiasm of a growing community dedicated to understanding and managing our dune, shingle, and machair systems. A book of abstracts is [available online](#), and presentations can be rewatched on the [Network's YouTube channel](#).



The conference Book of Abstracts is [available online](#)

30 Years of Foredune Notching

Insights and Lessons Learned

Dr Thomas Smyth, Sand Dune and Shingle Network Assistant



Foredunes notches in the National Park Zuid-Kennemerland, Netherlands. Image: Piet Nijssen ([Google maps](#))

30 Years of Foredune Notching: Insights and Lessons Learned brought together 68 researchers and practitioners from eight countries across Europe to reflect on three decades of foredune notching. Foredune notches are intentional gaps cut into coastal dune ridges to facilitate sediment transport, restore natural dune dynamics, and enhance ecological resilience. The format involved five experts giving talks, followed by an extended question and answer session with the audience. The talks captured a breadth of perspectives, ranging from long-term geomorphological monitoring and coastal engineering to policy shifts, ecological restoration, and public perception. This article summarises the key messages and lessons from each of the presentations.

Bas Arens : Notches in the Netherlands

Bas Arens, opened the session with a retrospective presentation on nearly 30 years of coastal notch development in the Netherlands and discussed how foredune notches allow wind-blown sand to move inland, supporting pioneer vegetation, building dune volume, and enhancing resilience to sea-level rise. Bas explained how notches were a product Dutch coastal policy in the 1990s which began to favour natural dynamics in foredunes, creating conditions for blowouts emerge and notches to be constructed.

In collaboration with his colleagues at HKV, Bas has documented the dynamic evolution of foredune notches, highlighting their growth patterns, sediment transport mechanisms, and relationships with wind direction and coastal orientation since 1996. Bas demonstrated how the surface area of notches can exponentially grow over time, though

some stabilise when embryonic dunes develop at their seaward edge. His talk underscored the value of long-term monitoring in understanding both the geomorphic and ecological roles of notches in coastal adaptation strategies.

Gerben Ruessink: Lessons from the *Noordwest-Natuurken Foredune Notches*

Gerben Ruessink followed with a detailed presentation on the *Noordwest-Natuurken* foredune notches on the Dutch coast, north of Bloemendaal aan Zee. Here, five large notches were excavated to stimulate inland sand movement and increase dune resilience to climate change. Using 39 digital elevation models and six years of wind data, Gerben demonstrated his first lesson of the presentation that foredune notches are effective conduits of beach sand beyond the foredune. This was exhibited by data showing a net gain of 18,000 cubic metres of sand landwards each year at the *Noordwest-Natuurken* foredune notches, thickening deposition lobes and contributing to long-term dune growth that exceeded sea level rise.

A second key lesson that Gerben presented was the discovery that a wide range of incident wind directions resulted in aeolian sediment transport within the notch. However, the data from anemometry within the notches demonstrated that as incident winds became more oblique to the orientation of the notch, higher wind speeds were required to produce sediment transport. Gerben concluded that as these systems evolve, ecological processes will become increasingly central to how notches function and persist.

Ken Pye - Frontal Dune Notching in the UK: Reflections and Opinions

Drawing on over 15 years of involvement in UK-based projects, Ken Pye offered a rich and candid reflection on the rationale, forms, and outcomes of foredune notching interventions across England and Wales. He proposed that notching should be seen not as a single technique, but as a spectrum, from shallow scrapes, to mid-depth notches, to full 'cuts' that breach the entire dune width. Each form varies in its cost, degree of intervention, and potential impact on sand mobility.

Ken illustrated how strategic placement, often in or adjacent to existing blowouts, can improve effectiveness, especially when paired with turf stripping. While UK dunes have stabilised dramatically since the mid-20th century, contributing to a major loss of bare sand habitats, notching and cutting offer a way to reactivate mobility and ecological processes.

The presentation summarised the results of key British case studies, which demonstrated varying levels success. At Kenfig which has a low sediment supply to the beach, early results were disappointing due to low wind energy and high rainfall following the interventions. In contrast, more recent trials at Ainsdale show promising signs of inland sand transport, aided by a more active sediment budget. A third project at Formby illustrated how notching can also serve remediation goals, helping to bury industrial waste and restore habitat function.

Ken concluded by advocating for adaptive, evidence-based practice and drew attention to the contrasting sediment

supplies to dunes, abundant in the Dutch examples, but generally limited in the British context. Success, he emphasised, depends on sediment availability, weather conditions, and a willingness to monitor and refine methods over time.

Bruno Castelle - Experimental Notching in Southwest France

Bruno Castelle presented research from southwest France, where foredune notching has been trialled in an environment that has been subject to over 150 years of coastal stabilisation. This region, once dominated by mobile dunes, has been heavily modified through afforestation and engineered interventions, resulting in long, uniform dune ridges that now restrict sediment exchange, especially in erosion-prone areas.

Bruno's team conducted a field experiment at Truc Vert beach, testing small-scale notches in both incipient and mature foredunes. Monitoring over two winters showed that even modest notches enhanced aeolian sand transport and deposition, particularly during storm events.

Initial vegetation surveys revealed that notches may also encourage higher species richness behind the intervention sites, supporting the argument for their ecological benefits. These results have already influenced coastal management in France, where larger-scale experiments like crest clipping of tall scarped foredunes are now being explored. The research points to a future where dune dynamism maybe carefully introduced to stabilised engineered landscapes especially where a tall dune scarps exist.

Satellite Images of Ainsdale before and after the works (Google Earth)



Evolution of foredune notches at Ainsdale Sand Dunes National Nature reserve (Image: Ken Pye)



Foredune notch at Newborough National Nature Reserve and Forest, Wales (June 2017)

Maria Michelsen - Dynamic Dunes in Denmark

The final presentation came from Maria Michelsen of Denmark's Ministry of the Environment, who introduced the forthcoming LIFE DYNAMICS initiative, a bold new project seeking to reintroduce natural processes to Denmark's highly stabilised coastal dunes. Unlike the other countries represented, Denmark has very limited experience with dynamic dune management. For over two centuries, its policies and public perception have framed dune mobility and bare sand as problems to be controlled.

Maria traced this legacy, including the use of afforestation, and even aerial fertiliser dispersal to suppress sand drift. Today, many Danish dunes appear stable but are ecologically degraded, with poor conservation status under Natura 2000. LIFE DYNAMICS aims to change this by piloting restoration of sand movement and natural dynamics at selected coastal sites.

The challenges are significant: fragmented systems, dense summerhouse developments, legacy infrastructure, and cultural barriers all constrain possibilities. Yet, the project represents a major shift in thinking. Emphasising learning and collaboration, Maria invited international partners to share their knowledge, particularly around planning and implementing foredune notching. Her presentation ended on a hopeful note, reflecting the broader spirit of shared experimentation and ecological renewal that defined the entire workshop.

Conclusion

Together, the five presentations portrayed a diverse yet complementary picture of foredune notching as a tool for restoring dynamism in coastal dune systems. The Dutch examples from Bas Arens and Gerben Ruessink demonstrating how notches can drive inland sand transport and promote both geomorphic resilience and ecological succession in an environment a high sediment supply. In contrast, Ken Pye's reflections from the UK highlighted the variability in outcomes due to more constrained sediment budgets and climate conditions, underscoring the need for site-specific strategies and adaptive management. Bruno Castello's work in southwest France bridged the established and the experimental, revealing how even small-scale notches can generate measurable geomorphic and ecological benefits within heavily engineered landscapes in an environment where dunes would be naturally dynamic. Finally, Maria Michelsen's overview from Denmark positioned notching within a policy and cultural shift, where re-mobilising stabilised dunes represents a new frontier in coastal management. While all speakers advocated for increased dynamism, their talks emphasised differing challenges, ranging from sediment availability and climate to public perception and historical land use, making clear that notching is not a one-size-fits-all solution, but a versatile tool shaped by local contexts and long-term commitment.

All the talks can also be watched again on our [YouTube channel](#).

Celebrate World Sand Dune Day - Saturday 28th June 2025

Originally established by the *Dynamic Dunescapes* and *Sands of LIFE* projects, both dedicated to restoring and protecting coastal sand dune systems, World Sand Dune Day is now being facilitated by the Sand Dune and Shingle Network, which continues to build momentum for this global celebration.

Falling this year on **Saturday 28th June 2025**, World Sand Dune Day offers a unique opportunity to celebrate the beauty, biodiversity, and cultural significance of sand dunes. These iconic landscapes are not only stunning but also play a vital role in coastal protection, habitat provision, and climate resilience.

Each year, the day is marked by a wide range of events and activities, organised by coastal communities, nature groups, and environmental projects around the world. From dune walks and wildlife surveys to family activities, talks, and volunteer days, there are plenty of ways to get involved.

To discover what's happening near you, or to access free educational resources, event ideas, and downloadable materials, please visit our dedicated World Sand Dune Day webpage: coast.hope.ac.uk/worldsandduneday

You can also stay connected via the [World Sand Dune Day Facebook page](#), where event highlights, stories, and dune facts are being shared in the lead-up to the day.

If you or your organisation are planning to host an event or have resources you'd like to contribute, we'd love to hear from you, please get in touch at dunes@hope.ac.uk.

#WorldSandDuneDay

2025 World Sand Dune Day Events

Guided tour Egmond aan Zee (Netherlands)

The excursion focuses on the history of the sea village landscape and the characteristic vegetation of the area. The guides are Gerjan Zwaan (historical geographer and native of Egmond) and Theo Bakker (hydrologist and great expert on the dunes).

Register [here](#) to attend.

Guided visit to the cross border dune site “Westhoek Nature Reserve and Dune du Perroquet” between De Panne (Belgium) and Bray-Dunes (France).

Come and visit the largest and most extensive dune area on the Flemish coast, with its shifting dunes, wet dune slacks, tall white dunes with Marram grass, grazing zones and dune formation on the beach. Come and discover the nature restoration works carried out as part of the LIFE and INTERREG projects co-financed by the European Union.

Further information is available [here](#).

Guided walk of Zwin Nature Park with a Dutch and French speaking guides (Belgium)

Enthusiastic guides will take you into the park and the Zwin plain. They know the tidal area like the back of their hand. Let their story carry you away. They will point out unique flowers in the salt marshes and the many (migratory) birds that visit the Zwin. A ticket for a weekend walk also gives access to the exhibitions, the hut trail, and the signposted walks in the Zwin plain.

Tickets for the event can be booked [here](#).



Upcoming Events

Site visit to Kenfig (Wales)

Wednesday 2nd July 2025 at 10.30 am

Join us for a visit to Kenfig National Nature Reserve on Wednesday, 2nd July 2025. This event hosted by Natural Resources Wales and the Sand Dune and Shingle Network will be a great opportunity to connect, share ideas, and explore one of Wales most extensive dune systems.

Schedule:

10:30 – 11:00 - Meet at Kenfig Visitor Centre

11:00 – 12:00 - Formal meeting & site introduction by Chris Jones (Site Warden)

12:00 – 15:00 - Guided site visit (bring your own lunch)

15:00 – 16:00 - Wrap-up discussions at the Visitor Centre

Please register on our [Events webpage](#) to confirm your attendance.

Sand Dune and Shingle Network Conference (Liverpool)

16th - 18th September 2025

Join us for the biennial Sand Dune and Shingle Network conference to explore the latest conservation strategies, challenges and research in sand dune, shingle and machair environments. Hosted by the Sand Dune and Shingle Network, this event brings together, practitioners, site managers, researchers and policymakers to share insights, discuss pressing issues, and shape the future of coastal management.

The event will focus around 4 sessions over 3 days:

- Emerging threats to sand dune, shingle and machair systems
- Conservation in Practice: Case studies and Lessons from the field

- Research and Innovation
- Policy, Practice and Impact: Shaping the Future of Coastal Conservation

The conference includes a field trip to the Wirral foreshore on Day 2 (Wednesday 17th September). A preliminary programme of the event is available [to view online](#).

Location

The location is Liverpool Hope University's Creative Campus, home to its creative and performing arts degrees. Based in the city centre of Liverpool, it is a stunning collection of Grade-II listed buildings.

Liverpool is famous for its cultural and sporting attractions and has more museums and galleries than any other UK city outside of the capital. It even has two cathedrals!

The Liverpool city region includes sites of international importance for the natural environment. These are between 10 minutes and 1 hour travel time of the conference venue. The coast of Liverpool offers an amazing combination of wildscapes that contrast starkly with an urban coastline and one of the busiest port complexes in Europe. Additional information about the venue and city is available [here](#).

Abstract Submission

The abstract submission deadline is **Monday 7th July 2025** via the [online form](#). Should your organisation require official correspondence regarding acceptance of your abstract prior to completing registration, please email your request to dunes@hope.ac.uk.

Registration

The registration fee for the event is £90. Payment is made via the Liverpool Hope University [online store](#). Registration includes lunches and refreshments on Tuesday 16th and Thursday 18th September. Additional detail and full terms and conditions of registration are available [here](#).



Recent Publications

Flora/Fauna

[Five-year carry-over effects in dune slack vegetation response to hydrology](#) (Ecological Indicators, 2025)

Dune slacks, seasonal wetlands found within sand dune systems, are highly influenced by local groundwater levels and are vulnerable to future climate change. This study tracked plant communities and groundwater conditions over nine years in 17 dune slacks to identify the most useful indicators of ecological change. By comparing 80 different hydrological measures with plant community responses, researchers found that a 5-year average of spring water levels was the most reliable predictor of vegetation response. This metric outperformed others because it avoided the distortions that maximum water levels can suffer from due to local topography. Importantly, it can also be collected with relatively little effort, just three months of spring monitoring each year as a minimum requirement. These findings offer practical guidance for site managers looking to track and respond to hydrological changes in dune slacks under a changing climate.

[Field-grown coastal dune plants exhibit similar survival, growth, and biomass in recycled glass substrate and natural beach sand](#) (Restoration Ecology, 2025)

This study assessed whether recycled glass sand, made from crushed glass bottles, could be used instead of dredged offshore sand for restoring coastal dunes after storm damage. Dredging is expensive and can harm marine ecosystems, so finding alternatives is important. Researchers compared the growth of three common dune plants, Sea oats, Beach morning-glory, and Railroad vine, across three soil types: natural beach sand, plain glass sand, and glass sand mixed with native soil microbes. All three species survived equally well in each soil type, and only small differences were observed in growth and biomass. These findings suggest that glass sand, even without added microbes, could be a practical and environmentally friendlier alternative for rebuilding dunes, helping to reduce the ecological and financial costs of coastal restoration.

[Does topography affect the ectomycorrhizal fungal community structure of Scots Pine \(*Pinus sylvestris* L.\) grown on the sand coastal dunes in Poland and Lithuania](#) (Forest Ecology and Management, 2025)

This research explored the diversity of fungi living in association with Scots pine roots in coastal dune forests along the southern and southeastern Baltic Sea, in Poland and Lithuania. These ectomycorrhizal (ECM) fungi play a key role in

supporting tree health and nutrient uptake. Across four afforested dune sites, 73 fungal species were identified. While overall species richness was consistent across different dune positions, subtle patterns emerged: fungi with short-range root associations were more common on the nutrient-poor upper slopes, whereas those with longer exploratory growth were found more often in lower areas with deeper organic layers and more developed vegetation. The depth of this organic layer was a major factor influencing fungal diversity. The ectomycorrhizal community was dominated by a few widespread species but also included rare and red-listed fungi, mostly on upper dune slopes. The findings of this study contribute to a better understanding of how topography and soil conditions influence below-ground biodiversity in coastal forest systems.

[Dieback of *Calluna vulgaris* in a Coastal Heathland After the 2018 Extreme Drought](#) (Journal of Vegetation Science, 2025)

This study investigated why *Calluna vulgaris* (heather) responded differently to the extreme 2018 drought on the Baltic island of Hiddensee. Using drone imagery, root sampling, and water table measurements, researchers found that plant dieback was most severe at higher elevations where groundwater dropped below root depth. Healthy plants were generally larger (taller with wider canopies) than weakened or dead neighbours, although all groups were similar in age and past growth. Damage persisted into 2019, with only 18% of previously affected plants recovering. Growth was linked to summer rainfall. The findings highlight the vulnerability of coastal heathlands to drought, particularly in drier, elevated areas, and the importance of climate-adaptive management strategies.

[The effect of a climatic compound drought and heatwave event on the dune-building grass *Elytrigia juncea*](#) (Plant and Soil, 2025)

This study examined how experimental drought and heatwave conditions affect the dune grass *Elytrigia juncea* (Sand Couch) in an embryonic dune field, comparing small and large plant patches. Surprisingly, both patch sizes showed positive growth responses to the stress, likely because roots accessed a nearby freshwater source, preventing drought stress. The results suggest that the ability of pioneer dune grasses to withstand extreme climate events depends more on landscape-scale freshwater availability than on local dune size, highlighting the importance of larger dune systems for climate resilience.

Management and Policy

[Predicting dune evolution on a regional scale for coastal management](#) (Ocean and Coastal Management, 2025)

This study examined recent sand dune changes at 31 sites along the coast of Cornwall, southwest England, revealing significant variation in how dunes behave even within a single region. The dunes showed a wide range of changes in both sand volume and position, with some sites losing sediment at rates up to $-12.4 \text{ m}^3/\text{m}/\text{year}$ and others gaining as much as $+5.1 \text{ m}^3/\text{m}/\text{year}$. Dune movement ranged from retreating inland at $-3.7 \text{ m}/\text{year}$ to advancing seaward at $+1.6 \text{ m}/\text{year}$. The study identified four distinct types of dune behaviour:

1. Volume gain with seaward advancement
2. Volume loss with landward retreat
3. Volume gain with retreat
4. Volume loss with advancement

These patterns illustrate the complexity of dune dynamics and the limitations of using simplified models like the Bruun Rule in isolation. However, when paired with observed site data, the Bruun Rule still helped identify coastal change 'hot-spots.' The authors recommend a tiered approach to dune forecasting: start with regional-scale projections based on trends and the Bruun Rule, then apply more detailed models in vulnerable areas. The author surmise that incorporating uncertainty into these predictions is essential for improving coastal management under climate change.

[A framework to mitigate aeolian erosion on nourished beaches](#) (Coastal Engineering, 2025)

This study examined how beach nourishment, particularly the construction of raised berms, affected wind and sand movement on sandy beaches. Using a combination of field measurements and numerical modelling, the researchers found that elevated berms increased wind speed in specific areas but also broke the beach into smaller "fetch" zones, limiting the development and movement of wind-driven sand. Based on these findings, they recommended a more refined nourishment design for windy coasts, involving a tiered and mechanically graded berm structure to help reduce aeolian sand transport beyond the beach which may cause a nuisance inland.

[Beach-dune dynamics and coastal management along the North-Médoc coastline, southwest France: a decade of morphological change and erosion mitigation](#) (Geomorphology, 2025)

Along the North-Médoc coastline in southwest France, an area exposed to strong waves, meso-macro tides, and

marked erosion hotspots, annual LiDAR surveys (2011–2023), revealed significant beach and dune volume changes over a 14.5 km stretch of coast. Long-term trends of erosion and accretion, reaching up to 7 m per year, were largely inherited from large-scale shoal welding processes at the nearby estuary mouth. Localised impacts arose from coastal defences: alongshore structures generally stabilised adjacent shoreline segments but induced downdrift disruption at their termini, while the extension of a groyne triggered rapid sediment build-up on its updrift side. Superimposed on these patterns was interannual variability driven by winter wave height fluctuations linked to broader shifts in weather systems across the North Atlantic. Wave-driven changes were most noticeable along the open coast, while estuary-related processes played a bigger role closer to the inlet.

[Ecological benefits of tourism management and the challenges of habitat classification](#) (Global Ecology and Conservation, 2025)

This article explored how grazing to reduce sward height and increase floral displays can benefit conservation, focusing on a Natura 2000 Special Area of Conservation with two habitat types: sensitive Machair Grassland and less sensitive Fixed Dunes in County Kerry (Ireland). The study found that well-managed grazing significantly increased plant diversity and that habitat classification directly influenced conservation outcomes and biodiversity protection. The findings challenge the common view that tourism always harms nature, suggesting that tourism and conservation can be mutually supportive when management goals are aligned and informed by appropriate habitat classification.

[Down the rabbit-hole: satellite-based analysis of spatio-temporal patterns in wild European rabbit burrows for better coastal dune management](#) (Journal of Coastal Conservation, 2023)

This study examined how wild European rabbits affected coastal dune erosion in Co. Donegal, Ireland, by mapping their burrow distribution and population changes. Burrows were found mainly on landward slopes, with rabbit activity varying yearly. The research shows that remote sensing using accessible satellite and drone imagery is an effective, practical tool for monitoring rabbit populations and improving mapping through automated analysis. The study also highlights a gap in understanding the ecological impact of this invasive species' burrowing, which can drive erosion and affect dune stability. It calls for further field research on burrow behaviour and its geomorphological effects to better guide dune conservation and management.

Geomorphology

[Morphological dynamics and vegetation interactions in coastal dunes: UAV-based insights from Pingtan Island, China](#) (Geomorphology, 2025)

This study from Tannan Bay, China, explored how vegetation and dune shape influence each other across different dune types and seasons. Using drone-based LiDAR and vegetation surveys, the researchers found that sand tended to accumulate on the windward slopes of dunes, particularly in winter, with patterns influenced by vegetation cover, storms, and local topography. Vegetation was mostly found on the windward sides and in low-lying areas between dunes, while blowouts occurred near inlets and depositional zones. The researchers reported a relationship between vegetation cover and dune elevation, with up to 6.7 cm of elevation being gained for every 1% increase in cover. This relationship was most strongly observed in spring and weakest in summer. The study offers useful insights into how vegetation affects dune development and erosion, with implications for managing and restoring coastal dune systems.

[The role of climate in determining foredune types and modes](#) (Coastal Engineering Journal, 2025)

This study explores how climate, especially rainfall, shapes the form and structure of coastal foredunes. The paper found that as rainfall decreased, vegetation cover became sparser and foredunes shifted from well-formed ridges to more irregular, broken-up shapes. In very dry regions with less than 300 mm of annual rainfall, only nebkha dunes tended to form. Examples from different climates showed that rainfall was a key driver of foredune type and structure. However, long-term shoreline stability or growth may also play a role in shaping dunes in certain locations.

[Narrowing down dune establishment drivers on the beach](#) (Biogeosciences, 2025)

This study examines how coastal dunes begin to form through the establishment of dune-building grasses under various environmental conditions on four Dutch beaches. Mapping over 1,800 plots revealed that most seedlings appeared near adult grasses, likely due to limited seed

dispersal or positive feedback effects. An experimental study using introduced seeds and rhizomes showed that successful establishment and dune initiation occurred where soil moisture was moderate (15–20%), salinity was low (<340 mS/m), and sediment movement was minimal. Dune initiation was most likely in mid-beach zones with moderate slopes and elevation. The study concluded that dune formation requires more specific conditions than simple plant establishment, highlighting the importance of both biological and environmental factors in predicting dune development.

[An experimental and numerical study of the morphodynamic response of a gravel beach profile under regular wave conditions](#) (Journal of Coastal Conservation, 2025)

This study explored how gravel beach profiles evolve under regular wave conditions, using both physical wave flume experiments and the process-based numerical model XBeach-G. The experiments tested two beach slopes (1:5 and 1:7) and two gravel sizes ($D_{50} = 2.6$ mm and $D_{50} = 7.1$ mm), collecting detailed hydrodynamic and morphological data. Results show that seepage through the beach surface significantly affects wave behaviour, including attenuation, velocity asymmetry, and breaker formation, all of which influence how the beach profile deforms over time. Overall, the findings offer new insights into the processes shaping gravel beaches and help refine modelling tools for coastal management.

[Analyzing topographic change profiles in coastal foredune systems: Methodological recommendations](#) (Geomorphology, 2025)

This study proposes a simple and objective method for measuring changes in foredune volume over time, which avoids the subjective challenges of identifying fixed features like the dune toe. Instead, it uses zero-crossings in topographic change profiles to define the limits of volume integration, focusing on areas where erosion shifts to accretion. This approach enhances understanding of long-term beach-dune system evolution.

This newsletter has been compiled by Thomas Smyth and Paul Rooney

Contact dunes@hope.ac.uk

Website coast.hope.ac.uk

Cover Photo Shingle ridge and dunes at Barmouth Beach, Wales (April 2024) (Thomas Smyth)

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